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950 L'Enfant Plaza, S.W.
Washington, D.C. 20024

TSLAP 80-9

Quarterly Technical Report

Maintenance Support for DARPA SATNET Packet
Communications System

As of 30 September 1980

Sponsored by:

Defense Advanced Research Projects Agency
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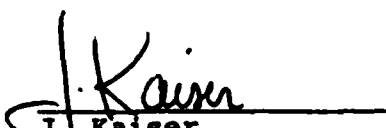
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MAINTENANCE

1. INTRODUCTION

One of the tasks in the maintenance work for the SATNET system is to build a spare PSP terminal to be used in the maintenance depot for checkout of failed and/or repaired units, and for the training of the maintenance personnel. Rather than duplicating the configuration of the terminals in the field, it was decided to reconfigure this terminal for added reliability and reduction in cost. This configuration will, of course, be completely compatible with the terminals in the field. Reconfiguration will be accomplished in three major areas:

(1) Subsystem modules- these will be P.C. boards instead of the previously used wire-wrap design. The new design of the modules will be physically and electrically compatible with the wire-wrap version, but will be more reliable and less expensive to manufacture and test than the previous models. The modules to be used as spares for the earth stations will also be designed this way, so that there will be about six to ten copies of each module, and thus there can be a cost saving, particularly in the checkout of each module.

(2) Power supplies- The terminals in the field have experienced failures in some of the power supplies. Whereas the supplies in the field will be left as they are, the maintenance PSP terminal will have redundant modular power supplies.

(3) Data Test Set- The present data test set is a specialized instrument, which is very costly to reproduce, uses high current and has limited capability. The new data test sets, one for the maintenance PSP terminal, and one as a spare unit for the earth stations, will be completely compatible with the units in the field, both electrically and mechanically. However, the new design will be a microprocessor controlled unit with a CRT readout. This

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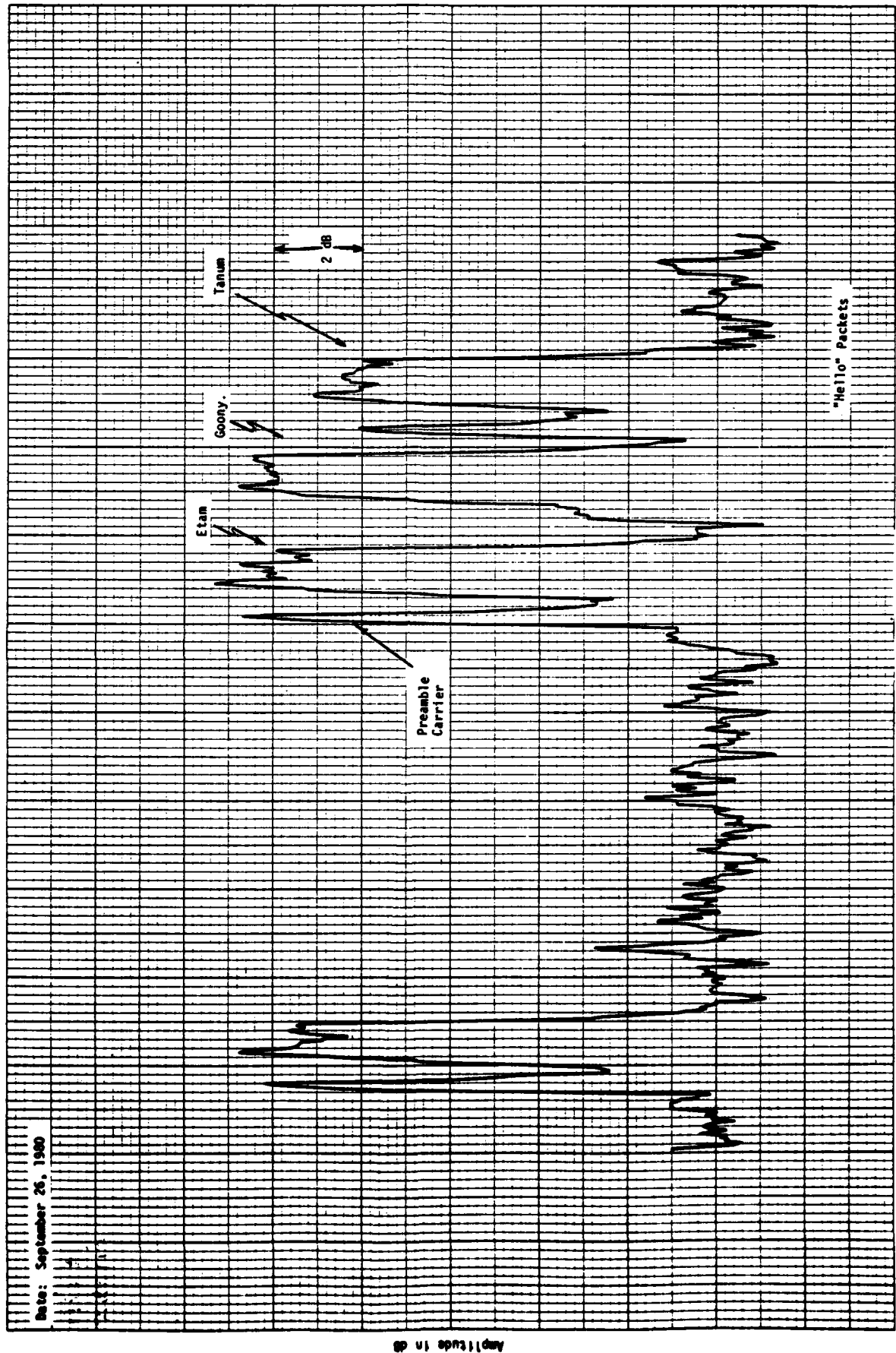


Figure 1
SATNET Packet Amplitude Envelopes

unit has the capability for additional functions that may aid in the upkeep of the network by allowing computations to be made on the T&M words that indicate the operation of the modems and the entire network.

2. SPARE MODEMS

The specifications for the spare modems to be constructed by LINKABIT has been reworked to incorporate required changes. One of the problems relating to the present modems is the stability of the 18 MHz oscillator on the modem card. This oscillator is used in the receive portion of the modem to convert the incoming signals to baseband. Unfortunately this oscillator is a temperature uncompensated oscillator with a temperature dependence of 1 ppm per degree C. This translates into a drift of -18 Hz per degree C. This in itself is not an intolerable drift, provided that the temperature of the unit in operation does not change by more than ± 10 degrees C. LINKABIT suggests that the frequency error of the modem should be less than ± 800 Hz for best operation of the demodulator. This oscillator is one of the contributors to the frequency error budget, and should therefore be well within the allowed deviation. The impact of the oscillator temperature dependence is in the maintenance of the PSP terminal, in that it makes setting the oscillator initially and during routine maintenance quite difficult. The frequency can be set only when the card is on an extender board, and then the temperature differs significantly from the normal operating temperature. The present modems have no provisions for monitoring or even measuring the frequency of this oscillator. A field modification was made to install a buffer amplifier and front panel test point to permit checking and monitoring the frequency of this oscillator when the unit is operating in its normal mode. Tanum and Goonhilly have been supplied with these modifications and the frequencies of the

oscillators in the modems for these earth terminals have been set to the proper values. the modems for ETAM will also be modified and the frequency set to its appropriate value.

3. T&M WORDS

The original design of the PSP terminal digital modems and interfaces provided for Telemetry and Monitoring (T&M) information on the operation of the modem. These T&M words had not been turned on because they were found to cause certain errors to be recorded by the SIMP under some conditions. That is, it was possible for some of the T&M words to appear like a DLE and thus abort the demodulation of the full packet. This problem has been corrected and the T&M words have been turned on at ETAM. It is now necessary to calibrate the T&M words for all three earth stations so that conclusions can be drawn from them regarding the operation of the system.

It was noted during testing at COMSAT Labs that the T&M words representing the AGC and eventually the per packet E_b/N_o were not very useful in view of nonlinearities, coarseness of measurement and data dispersion.

A meeting was held at DARPA to discuss what possible action could be taken to remedy this problem. It was decided to change the algorithms used to derive these T&M words. This requires reprogramming of PROMS for the modems and interfaces at LINKABIT. This process is under way. In the mean time, an effort will be made to accumulate data and experience on the use of the T&M words for determining the operation of the network. When the new proms are available they will be tested at COMSAT Labs and then they will be placed into service at the earth stations in a carefully programmed manner so that this process will not disturb the operation of the net.

4. SYSTEM OPERATION

As part of the maintenance effort a system operations monitoring set has been assembled. This facility allows the monitoring of the amplitude envelope of signals from the three earth stations in the system. A representative sample is shown in Figure 1. The monitoring equipment requires operator selection of "Hello" packets from the packet stream. The equipment is also used for other purposes, and therefore the monitoring is done primarily when there is reason to suspect that the transmitted signals are not properly aligned in power. The packet bit stream is received at the UET in Clarksburg, and the samples are taken at 70 MHz. There is no way to determine the absolute value of the signal levels, but the relative values of the signal powers can be measured fairly accurately. Figure 1 shows that ETAM and Goonhilly are roughly at the same power level and TANUM is about 2 dB lower. It is also noted that ETAM and TANUM still have the pure carrier preamble turned on. This has been turned off at Goonhilly. This preamble is not needed now, since the entire system is operating with the PSP terminals instead of the SPADE modems. Unfortunately the "preamble-on" condition is a default condition whenever a SIMP is reset and the PSP C&MM is in the automatic mode. The preambles can be turned off on command from BBN.

When the T&M words are working properly, they will show about the same information now obtained from the power envelopes, and the present monitoring can be stopped in favor of monitoring the T&M words.